U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER^{TM} iPWR DESIGN

8.1 ELECTRIC POWER – INTRODUCTION

REVIEW RESPONSIBILITIES

Primary - Organization responsible for electrical engineering

Secondary - None

I. AREAS OF REVIEW

The specific areas of review are as follows:

1. The applicant's description of the offsite power system with regard to the interrelationships between the nuclear unit(s), the utility grid, and any interconnecting grids.

2. The applicant's description of the onsite power systems with regard to the availability of sufficient power to mitigate design-basis events given a loss of the offsite power system and a single failure in the onsite power system.

3. The applicant's description of the capability to withstand and recover from a station blackout (SBO) event of a specified duration. For passive plants, this duration has been established as 72 hours without operator intervention[1] (refer to Standard Review Plan (SRP) Section 19.3 for post design-basis accident and beyond 72 hour requirements).

4. The acceptance criteria to be implemented in the design of the above systems.

5. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this design-specific review standard (DSRS) section in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this DSRS section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.

6. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).

   For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced

[1] Refer to SECY-94-084, March 28, 1994 (ADAMS Accession No. ML003708098)

DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

Review Interfaces

DSRS Sections 8.2, 8.3.1, 8.3.2, and 8.4 contain the specific review interfaces for each DSRS section.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. Table 8-1 of this DSRS section lists the acceptance criteria the staff currently applies to electric power systems as modified for the mPower™ integral pressurized-water rector (iPWR) design. Implementation of these criteria in accordance with applicable regulatory guides (RGs) and branch technical positions (BTPs) will provide assurance that systems will perform their design safety functions when required.

2. DSRS Sections 8.2, 8.3.1, 8.3.2, and 8.4 detail the specific acceptance criteria presented in Table 8-1. Each DSRS section also describes the technical rationale for applying these criteria to reviews of electrical power systems.

3. Title 10 of the *Code of Federal Regulations* (CFR), Section 52.47(b)(1), which requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the DC has been constructed and will be operated in conformity with the DC, the provisions of the Atomic Energy Act (AEA), and the U.S. Nuclear Regulatory Commission's (NRC's) regulations;

4. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the AEA, and the NRC's regulations.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are set forth below. The DSRS is not a substitute for the NRC's regulations, and compliance with it is not required. Identifying the differences between this DSRS section and the design features, analytical techniques, and procedural measures proposed for the facility, and discussing how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria, is sufficient to meet the requirements in 10 CFR 52.47(a)(9), "Contents of applications; technical information." The same approach may be used to meet the requirements of 10 CFR 52.79(a)(41) for COL applications.

III. REVIEW PROCEDURES

These review procedures are based on the identified DSRS acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

The staff will review Section 8.1 of the safety analysis report (SAR) to ensure that it includes (1) a brief description of the utility grid and its interconnections to other grids and to the nuclear unit, (2) a brief general description of the onsite power system, (3) a brief description of the alternate alternating current (AAC) power source, if provided for SBO, and the associated interconnections to safety buses, (4) and the design bases, criteria, standards, RGs, and technical positions that will be implemented in the design of the electric power systems, including a description of the extent to which these criteria and guidelines are followed and a positive statement that the design conforms to each.

The staff will perform the review as follows:

1. In accordance with 10 CFR 52.47(a)(8),(21), and (22), for new reactor license applications submitted under Part 52, the applicant is required to (1) address the proposed technical resolution of unresolved safety issues and medium- and high-priority generic safety issues that are identified in the version of NUREG-0933 current on the date 6 months before application and that are technically relevant to the design; (2) demonstrate how the operating experience insights have been incorporated into the plant design; and, (3) provide information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v). These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions documented in the corresponding safety evaluation report (SER) section.

2. The staff will establish that the utility grid is adequately described, and that the interconnections between the nuclear unit, the utility grid, and other grids are clearly defined. The descriptions should state whether facilities are existing or planned; if planned, the respective completion dates should be provided.

3. The staff will confirm that the onsite power system is briefly described and that Section 8.3.1 and 8.3.2 of the SAR presents more detailed information.

4. The staff will confirm that the AAC power source, if provided for SBO, is briefly described and that Section 8.4 of the SAR provides more detailed information. This design feature may not be applicable to the passive mPower^{TM} design. If not applicable, the bases for acceptance of such a design should be documented in Section 8.4.

5. The staff will confirm that Table 8-1 lists the criteria and guidelines identified as being applicable to the design of electric power systems. The SAR should discuss the applicability of the criteria and guidelines listed and include a statement to the effect that they will be implemented or are implemented in the design of electrical power systems.

6. General Design Criterion (GDC) 17 found in Appendix A to 10 CFR Part 50 contains the requirements for the offsite and onsite electric power systems. Table 8-2 provides the staff interpretation of GDC 17.

7. For review of the mPower™ DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the final safety analysis report (FSAR) meets the acceptance criteria. The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR.

   For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

   For review of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of Section 8.0.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's SER. The reviewer also states the bases for those conclusions.

1. Section 8.1 of the SAR provides (1) a brief description of the utility grid and its interconnections to other grids and the nuclear unit, (2) a brief general description of the onsite alternating current and direct current power system, (3) a brief description of the AAC power source (if provided for SBO), and (d) the design criteria that have been implemented in the design of the electric power systems.

2. The staff has determined that an electric power system design that conforms to the applicable GDC, RGs, and BTPs set forth in Table 8-1 provides a sufficient basis for acceptance of the electric power system.

3. The staff concludes that the design criteria that have been implemented for the electric power system are in accordance with the acceptance criteria listed in Table 8-1 and are acceptable as noted below in the following sections of Chapter 8.

For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this DSRS section.

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

V. IMPLEMENTATION

The staff will use this DSRS section in performing safety evaluations of mPower™-specific DC, or COL, applications submitted by applicants pursuant to 10 CFR Part 52. The staff will use the method described herein to evaluate conformance with Commission regulations.

Because of the numerous design differences between the mPower™ and large light-water nuclear reactor power plants, and in accordance with the direction given by the Commission in SRM-COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights to Enhance the Safety Focus

of Small Modular Reactor Reviews," dated August 31, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102510405), to develop risk-informed licensing review plans for each of the small modular reactor reviews, including the associated pre-application activities, the staff has developed the content of this DSRS section as an alternative method for mPower^{TM}-specific DC, or COL submitted pursuant to 10 CFR Part 52 to comply with 10 CFR 52.47(a)(9), "Contents of applications; technical information."

This regulation states, in part, that the application must contain "an evaluation of the standard plant design against the Standard Review Plan (SRP) revision in effect 6 months before the docket date of the application." The content of this DSRS section has been accepted as an alternative method for complying with 10 CFR 52.47(a)(9), as long as the mPower^{TM} DCD FSAR does not deviate significantly from the design assumptions made by the NRC staff while preparing this DSRS section. The application must identify and describe all differences between the standard plant design and this DSRS section, and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria. If the design assumptions in the DC application deviate significantly from the DSRS, the staff will use the SRP as specified in 10 CFR 52.47(a)(9). Alternatively, the staff may supplement the DSRS section by adding appropriate criteria in order to address new design assumptions. The same approach may be used to meet the requirements of 10 CFR 52.79(a)(41), for COL applications.

VI. REFERENCES

1. See Table 8-1 for references.

DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER™
TABLE 8-1
ACCEPTANCE CRITERIA AND GUIDELINES FOR ELECTRIC POWER SYSTEMS

The matrix of Table 8-1 identifies the acceptance criteria (denoted by "A") and the guidelines (denoted by "G") and their applicability to the various sections of DSRS Chapter 8 for the mPower+ design. The acceptance criteria define the Commission's requirements for power systems that are important to safety. The guidelines amplify these requirements and provide a more explicit basis upon which to evaluate the conformance of the power systems to these requirements. This table does not include acceptance criteria and guidelines for those aspects of the power systems that are reviewed in accordance with sections other than DSRS Chapter 8.

The BTPs are listed in the table.

CRITERIA	TITLE	APPLICABILITY (DSRS Section) 8.2	8.3.1	8.3.2	8.4	REMARKS [a]
1. General Design Criteria, Appendix A to 10 CFR Part 50						
a. GDC 2	Design Bases for Protection Against Natural Phenomena		A	A		8.2 See ADAMS Accession No. ML090260039
b. GDC 4	Environmental and Dynamic Effects Design Bases		A	A		8.2 See ADAMS Accession No. ML090260039
c. GDC 5	Sharing of Structures, Systems, and Components	A	A	A		
d. GDC 17	Electric Power Systems	A	A	A	A	
e. GDC 18	Inspection and Testing of Electrical Power Systems	A	A	A	A	
f. GDCs 33, 34, 35, 38, 41, and 44		A*	A*	A*		As they relate to the operation of electric power systems, encompassed in GDC 17, to ensure that the safety functions of the systems described in GDCs 33, 34, 35, 38, 41, and 44 are accomplished.
g. GDC 50	Containment Design Bases		A	A		

CRITERIA	TITLE	APPLICABILITY (DSRS Section) 8.2	8.3.1	8.3.2	8.4	REMARKS [a]
2. Regulations (10 CFR Parts 50 and 10 CFR 52)						
a. 10 CFR 50.34	Contents of Applications; Technical Information					For new reactor license applications submitted under 10 CFR Part 52, the application should include a table that identifies (a) TMI requirements set forth in 10 CFR 50.34(f); (b) those unresolved safety issues and medium- and high-priority generic safety issues that are identified in the version of NUREG-0933 current on the date up to 6 months before the submittal date of the application and that are technically relevant to the design, and (c) the application section where resolutions are addressed. See NUREG-0737, "Clarification of TMI Action Plan Requirements."
i. 50.34(f)(2)(v)	(Related to TMI Item I.D.3)	A	A	A		
ii. 50.34(f)(2)(xiii)	(Related to TMI Item II.E.3.1)		A			
iii. 50.34(f)(2)(xx)	(Related to TMI Item II.G.1)		A			
b. 10 CFR 50.55a	Codes and Standards		A*	A		Paragraph (h) incorporates IEEE Std. 603 and specifies application of IEEE Std. 603 and IEEE Std. 279. See also: RG 1.153.
c. 10 CFR 50.63	Loss of All Alternating Current Power				A	
d. 10 CFR 50.65(a)(4)	Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power	A	A	A	A	Paragraph (a)(4),as it relates to the assessment and management of the increase in risk that may result from

CRITERIA	TITLE	APPLICABILITY (DSRS Section) 8.2	8.3.1	8.3.2	8.4	REMARKS [a]
	Plants					proposed maintenance activities before performing the maintenance activities.
e. 10 CFR 52.47(b)(1)	Contents of Applications	A	A	A	A	Paragraph (b)(1), as it relates to ITAAC (for design certification) sufficient to assure that the SSCs in this area of review will operate in accordance with the certification.
f. 10 CFR 52.80(a)	Contents of Applications; Additional Technical Information	A	A	A	A	
3. Regulatory Guides						
a. RG 1.6	Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems		G*	G		
b. RG 1.68	Initial Test Programs for Water-Cooled Nuclear Power Plants	G*	G*	G*	G*	
c. RG 1.32	Criteria for Power Systems for Nuclear Power Plants	G*	G*	G		§8.2 As it relates to safety-related (Class 1E) and/or risk-significant SSCs. §8.3.1 As it relates to safety-related (Class 1E) and / or risk-significant SSCs . §8.3.2 as it relates to the design, operation, and testing of the safety-related (Class 1E) SSCs of the dc power system.
d. RG 1.47	Bypassed and Inoperable		G*	G		As it relates to safety-related and / or

CRITERIA	TITLE	APPLICABILITY (DSRS Section) 8.2	8.3.1	8.3.2	8.4	REMARKS [a]
	Status Indication for Nuclear Power Plant Safety Systems					risk-significant SSCs.
e.RG 1.53	Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems		G*	G		See also: IEEE Std. 379-2003, "Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems," as endorsed by RG 1.53.
f. RG 1.63	Electric Penetration Assemblies in Containment Structures for Nuclear Power Plants		G	G		See also: IEEE Std. 242-1986, "IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems"; IEEE Std. 317-1983 (reaffirmed 1992), "IEEE Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations"; and Section 5.4 of IEEE Std. 741-1986, "Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations," as endorsed by RG 1.63.
g.RG 1.75	Physical Independence of Electric Systems		G	G		See also: IEEE Std. 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," as endorsed by RG 1.75.
h.RG 1.81	Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants		G	G		§8.3.1 As it relates to the sharing of SSCs of the onsite ac power system - Regulatory Positions C.2 and C.3. §8.3.2 As it relates to the sharing of SSCs of

CRITERIA	TITLE	APPLICABILITY (DSRS Section) 8.2	8.3.1	8.3.2	8.4	REMARKS [a]
						the dc power system, noting that Regulatory Position C.1 states that multiunit sites should not share dc systems.
i. RG 1.106	Thermal Overload Protection for Electric Motors on Motor-Operated Valves		G*	G		
j. RG 1.118	Periodic Testing of Electric Power and Protection Systems		G*	G		See also: IEEE Std. 338-1987, "IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems," as endorsed by RG 1.118.
k. RG 1.128	Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants			G		See also: IEEE Std. 484-2002, "IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Storage Batteries for Stationary Application," as endorsed by RG 1.128. In addition, IEEE Std. 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications," provides a method acceptable to the staff for sizing stationary lead acid batteries.
l. RG 1.129	Maintenance, Testing, and Replacement of Vented Lead-Acid Storage Batteries for Nuclear Power Plants			G		See also: IEEE Std. 450-2002, "IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Application," as endorsed by RG 1.129.
m. RG 1.153	Criteria for Safety Systems		G*	G		See also: IEEE Std. 603, "IEEE Standard Criteria for Safety Systems for

CRITERIA	TITLE	APPLICABILITY (DSRS Section) 8.2	8.3.1	8.3.2	8.4	REMARKS [a]
						Nuclear Power Generating Stations" as incorporated by 10 CFR 50.55a(h) and endorsed by RG 1.153
n.RG 1.155	Station Blackout				G	See also: NUMARC 8700, “Guidelines and Technical Bases for NUMARC Initiatives Addressing SBO at Light Water Reactors,” Revision 0, November 1987, as endorsed by RG 1.155.
o.RG 1.160	Monitoring the Effectiveness of Maintenance at Nuclear Power Plants	G	G	G	G	See also: NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Revision 2, April 1996, as endorsed by RG 1.160.
p.RG 1.182	Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants	G	G	G	G	
q. RG 1.204	Guidelines for Lightning Protection of Nuclear Power Plants	G	G	G	G	See also: IEEE Std. 665-1995 (Reaffirmed 2001), ”IEEE Standard for Generating Station Grounding,” IEEE Std. 666-1991 (Reaffirmed 1996), “Design Guide for Electric Power Service Systems for Generating Stations“; IEEE Std. 1050-1996, ”Guide for Instrumentation and Control Equipment Grounding in Generating Stations”; IEEE Std. C62.23-1995 (Reaffirmed 2001), ”Application Guide for Surge Protection of Electric Generating Plants,” as endorsed by RG 1.204.
r. RG 1.206	Combined License Applications for Nuclear	G	G	G	G	RG 1.206 provides guidance for the review of SARs submitted by COL

CRITERIA	TITLE	APPLICABILITY (DSRS Section) 8.2	8.3.1	8.3.2	8.4	REMARKS [a]
	Power Plants (LWR Edition)					applicants and contains criteria applicable to all sections of DSRS Chapter 8.
4. Branch Technical Positions						
a. BTP 8-2	Use of Onsite AC Power Sources for Peaking		G		G	
b. BTP 8-3	Stability of Offsite Power Systems	G				
c. BTP 8-6	Adequacy of Station Electric Distribution System Voltages	G	G			
5. NUREG Reports						
a. NUREG-0718, Revision 1	Licensing Requirements for Pending Applications for Construction Permits and Manufacturing License		G*	G		See TMI Item I.D.3, "Safety System Status Monitoring," regarding application of RG 1.47.
b. NUREG-0737	Clarification of TMI Action Plan Requirements		A*			See TMI Items II.E.3.1,"Emergency Power Supply for Pressurizer Heaters," and II.G.1, "Emergency Power for Pressurizer Equipment."
c. NUREG/CR-0660	Enhancement of Onsite Diesel Generator Reliability		G*			Reference Only
d. NUREG-1793	Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design	G	G	G	G	NUREG-1793 provides the staff's safety review of the AP1000 standard design against the requirements of 10 CFR Part 52, Subpart B and describes the basis for acceptance of passive features and systems not found in current operating reactors specific to the

CRITERIA	TITLE	APPLICABILITY (DSRS Section) 8.2	8.3.1	8.3.2	8.4	REMARKS [a]
						AP1000 design.
6. Commission Papers (SECY)						
a. SECY-90-016	Evolutionary Light Water Reactor Certification Issues and Their Relationships to Current Regulatory Requirements,1990	A*	A*		A*	As it relates to the use of AAC power sources and application of RTNSS at ALWRs provided with passive safety systems.
b. SECY-94-084	Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs, 1994	A*	A*		A*	As it relates to the use of AAC power sources and application of RTNSS at ALWRs provided with passive safety systems.
c. SECY-95-132	Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs, 1995	A*	A*		A*	As it relates to the use of AAC power sources and application of RTNSS at ALWRs provided with passive safety systems.
d. SECY-91-078	EPRI's Requirements Document and Additional Evolutionary LWR Certification Issues, 1991	G*	G*		G*	As it relates to the inclusion of an alternate power source to nonsafety-related loads at evolutionary plant designs.
e. SECY-05-0227	Final Rule: AP1000 Design Certification, 2005	G				As it relates to an exemption to the GDC 17 requirement for two physically independent offsite circuits specifically for the AP1000 passive reactor design.

[a] Related industry standards and guidelines are included for reference only. Refer to the specific DSRS section for applicability. The staff will review new applications using the latest version of industry codes and standards endorsed by the NRC. Proposed use of unendorsed versions of codes and standards will be reviewed on a case-by-case basis.

*The reviewer must determine if the specific acceptance criteria apply to the iPWR mPower™ finalized design when presented for staff review (DCD).

TABLE 8-2

NRC STAFF INTERPRETATION OF THE REQUIREMENTS OF GDC 17

This criterion provides a deterministic delineation of the minimum requirements for the offsite and onsite electric power systems (i.e., in terms of specific system and circuit configuration and functional requirements). The only requirement in GDC 17 for explicitly meeting the single failure criterion relates to the onsite power system. In applying GDC 17, the staff has found it useful to also interpret the deterministic requirements for the offsite power system in terms of required conformance to the single failure criterion. The text of GDC 17, presented in the left column of Table 8-2, is keyed to the staff interpretation of its deterministic requirements and the corresponding staff interpretations regarding conformance to the single failure criterion.

GDC 17	Staff Interpretation
Criterion 17, Electric power systems. An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.	a. Both an offsite and onsite power system shall be provided, each independent of the other and capable of providing power for all safety functions. (The offsite and onsite power systems considered together must meet the single failure criterion on a system basis without losing the capability to provide power for <u>all</u> safety functions. In addition, in view of requirement (b) below, the two systems considered together must be capable of sustaining a complete loss of offsite power and a single failure in onsite system, without losing the capability to provide power for the <u>minimum required</u> safety functions.)
The onsite electric power supplies, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions assuming a single failure.	b. The complete onsite electric power system (Class 1E) must be capable of sustaining a single failure without loss of capability to provide power for the <u>minimum required</u> safety function.

GDC 17	Staff Interpretation
Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights of way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. A switchyard common to both circuits is acceptable.	c. The offsite system shall be comprised of a minimum of two physically independent circuits connecting the transmission network (grid) to the onsite distribution system (safety buses). (Separate transmission line towers are required but common switchyard structures are acceptable. There is no requirement for meeting the single failure criterion, and in the absolute sense, this criterion cannot be met because there is only one power source, the grid.)
Each of these circuits shall be designed to be available in sufficient time following a loss of all onsite alternating current power supplies and the other offsite electric power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded.	d. Each of the two required offsite power circuits shall be designed to be available in sufficient time to effect safe shutdown in the event of a loss of all onsite power and the loss of the other offsite circuit. (The staff has designated the second circuit as the "delayed access circuit." The offsite power system (i.e., the two circuits considered together, must meet the single failure criterion, but only with respect to the delayed access circuit function.))
One of these circuits shall be designed to be available within a few seconds following a loss-of-coolant accident to assure that core cooling, containment integrity, and other vital safety functions are maintained.	e. One of these circuits shall be designed to be available within a few seconds following a loss-of-coolant accident. (The staff has designated this circuit as the "immediate access circuit." Because only one such circuit is required, the offsite power system need not meet the single failure criterion with respect to its immediate access function.)
Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.	f. Analyses (performed by the utility) must verify that the grid remains stable in the event of a loss of the nuclear unit generator, the largest other unit on the grid, or the most critical transmission line. (There is no specific requirement for meeting the single failure criterion. However, overlapping requirement (a) above requires the offsite/onsite power systems to meet this criterion on a system basis.)